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The Planar Nernst Effect and the Search for Thermal Spin Currents in Ferromagnetic Metals[1]

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One possible model for future nanoelectronic circuits that will be faster and more efficient is based on the spin, rather than only the charge of electrons. An essential ingredient for this future is a reliable source of a pure spin current, a transfer of angular momentum without flow of charge. Over the past few years some groups have reported that such a spin current can be generated simply by applying a thermal gradient to a ferromagnetic material. This effect, called the spin Seebeck effect (SSE), has generated tremendous interest in the interaction of heat, charge and spin in ferromagnetic systems. In this talk we will present our own recent measurements of thermoelectric and thermomagnetic effects in thin film metallic ferromagnets. These are enabled by a micromachined thermal isolation platform that removes potentially confounding effects introduced in such measurements by the presence of a highly thermally conductive bulk substrate. One of the main results is the observation of a transverse thermopower, called the planar Nernst effect (PNE), that is caused by spin-dependent scattering. This PNE should therefore be present in any attempted measurement of the SSE in a metal system where spin-dependent scattering of electrons occurs. Furthermore our "zero substrate" experiment shows no signal with the symmetry of the SSE, suggesting the presence of the substrate is required to cause such a signal. Further experiments are required to determine if a pure spin current is actually involved in the generation of the signal associated with the SSE in metal films.

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